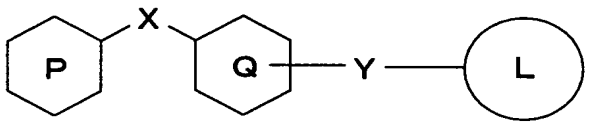
CLAIMS

1. A GPR40 receptor function regulator comprising a compound having an aromatic ring and a group capable of releasing cation.

2. The regulator of claim 1, which comprises a carboxylic acid having an aromatic ring, or a derivative thereof.

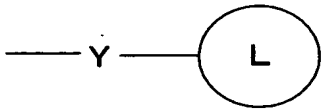
3. The regulator of claim 1, which comprises a carboxylic acid having two or more aromatic rings, or a derivative thereof.

4. The regulator of claim 1, which comprises a compound represented by the formula

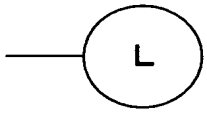


(I')

wherein ring P is an aromatic ring optionally having substituent(s), ring Q is an aromatic ring optionally further having substituent(s) besides

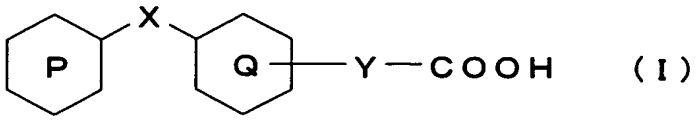


, X and Y are each a spacer, and



is a group capable of releasing cation, or a salt thereof or a prodrug thereof.

5. The regulator of claim 2, which comprises a compound represented by the formula

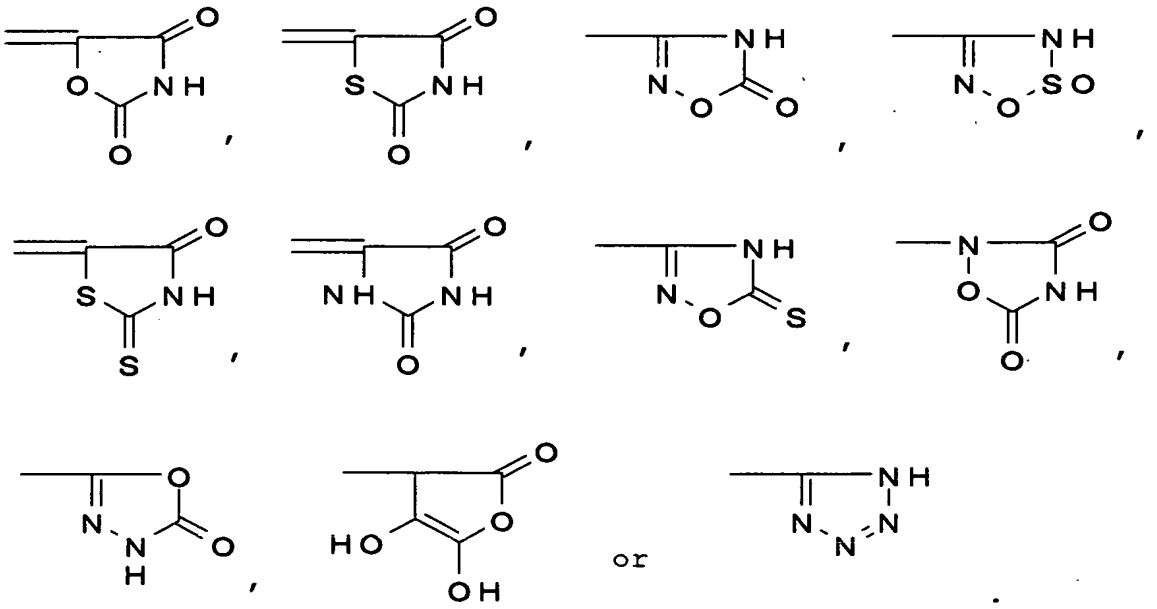


(I)

wherein ring P is an aromatic ring optionally having substituent(s), ring Q is an aromatic ring optionally further having substituent(s) besides -Y-COOH, X and Y are each a spacer, and -Y-COOH is substituted at any position on ring Q, or a salt thereof or a prodrug thereof.

6. The regulator of claim 1, wherein the group capable of releasing cation is (1) a 5-membered heterocyclic group capable of releasing cation, (2) a carboxyl group, (3) a sulfonic acid group, (4) a sulfamoyl group optionally mono-substituted by a C_{1-4} alkyl group, (5) a phosphonic acid group, (6) a carbamoyl group optionally mono-substituted by a C_{1-4} alkyl group, (7) a C_{2-7} alkylsulfonylthiocarbamoyl group or (8) a trifluoromethanesulfonic acid amido group ($-NHSO_2CF_3$).

7. The regulator of claim 1, wherein the group capable of releasing cation is

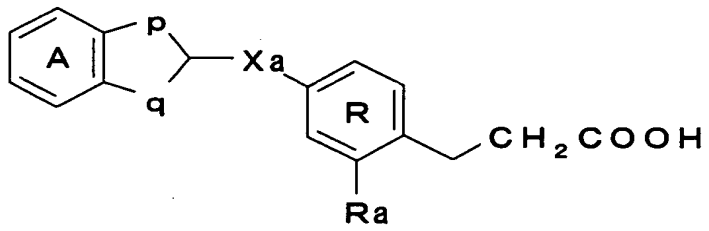


8. The regulator of claim 1, which is an insulin secretion

modulator, a hypoglycemic agent or a pancreatic β cell protector.

9. The regulator of claim 1, which is an agent for the prophylaxis or treatment of diabetes, impared glucose tolerance, ketosis, acidosis, diabetic neuropathy, diabetic nephropathy, diabetic retinopathy, hyperlipidemia, genital disorder, skin disease, arthropathy, osteopenia, arteriosclerosis, thrombotic disease, dyspepsia, memory and learning disorder, obesity, hypoglycemia, hypertension, edema, insulin resistance syndrome, unstable diabetes, fatty atrophy, insulin allergy, insulinoma, lipotoxicity, hyperinsulinemia, or cancers.

10. A compound represented by the formula

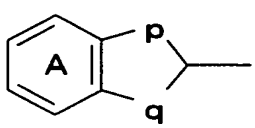


(I — 1)

wherein ring A is a benzene ring optionally having substituent(s), ring R is a phenylene group optionally having substituent(s), Xa is a spacer other than an alkylene group, p and q are each a C_{0-4} carbon chain optionally having substituent(s), and Ra is a hydrogen atom or a substituent, or a salt thereof.

11. A prodrug of the compound of claim 10 or a salt thereof.

12. The compound of claim 10, wherein the partial structural formula



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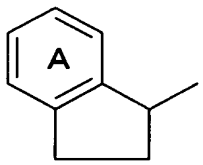

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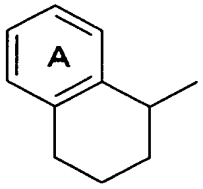
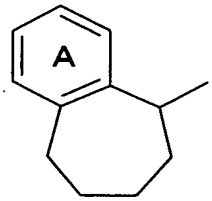


or


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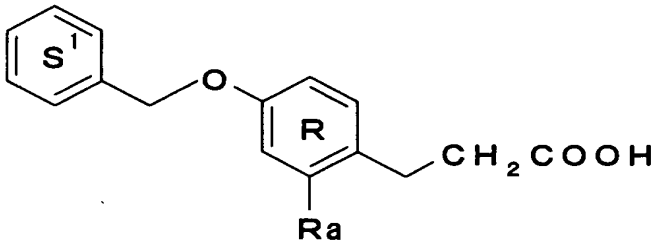
the substituent that ring A optionally has is (1) a halogen atom, (2) a C_{1-6} alkyl group, (3) a C_{1-6} alkoxy group, (4) a C_{6-14} aryl group optionally substituted by a halogen atom, a C_{1-6} alkyl or a C_{1-6} alkoxy, (5) a C_{6-14} aryloxy group or (6) a C_{7-16} aralkyloxy group,

the substituent that ring R optionally has is a halogen atom or a C_{1-6} alkyl group,

Ra is a hydrogen atom, and

the spacer represented by Xa is an oxygen atom.

13. A compound represented by the formula



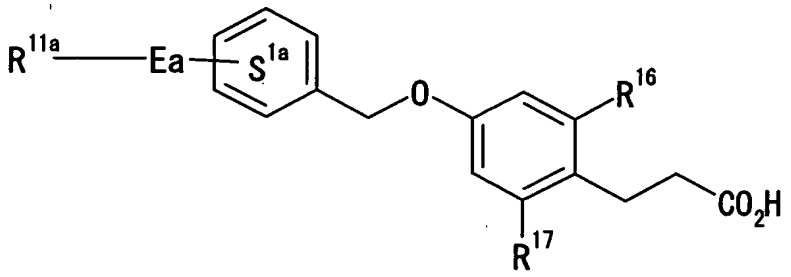
(I−2)

wherein ring S^1 is a benzene ring having substituent(s) having a benzene ring, ring R is a phenylene group optionally having substituent(s), and Ra is a hydrogen atom or a substituent, or a salt thereof, except (i) 2-ethoxy-4-[[2-[(5-methyl-2-phenyl-4-oxazolyl)methoxy]phenyl]methoxy]benzenepropanoic acid, (ii) 2-ethoxy-4-[[3-[(5-methyl-2-phenyl-4-oxazolyl)methoxy]phenyl]methoxy]benzenepropanoic acid, (iii) 2-ethoxy-4-[[4-[(5-methyl-2-phenyl-4-oxazolyl)methoxy]phenyl]methoxy]benzenepropanoic acid, and (iv) 4-[[4-[(5-methyl-2-phenyl-4-oxazolyl)methoxy]phenyl]methoxy]benzenepropanoic acid.

14. A prodrug of the compound of claim 13 or a salt thereof.

15. The compound of claim 13, wherein the substituent(s) having a benzene ring is a substituent represented by the formula: R^{11}-E^2- (R^{11} is a phenyl group, an indanyl group or a naphthyl group, each optionally having substituent(s), and E^2 is a bond or a spacer), and the spacer represented by E^2 is -$(CH_2)m^1$-W^1-$(CH_2)m^2$- (m^1 and m^2 are each an integer of 0 to 3, W^1 is -O-, -N(R^2)-, -S-, -CO- or -CO-N(R^3)-, and R^2 and R^3 are each a hydrogen atom or a C_{1-6} alkyl group).

16. The compound of claim 13, which is represented by the formula



(I-2A)

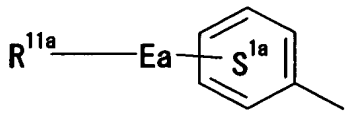
wherein R^{11a} is a phenyl group having 1 or 2 substituents, Ea is a bond, an oxygen atom or an optionally substituted methylene, ring S^{1a} is a benzene ring optionally further having substituent(s) selected from an optionally substituted C_{1-6} alkyl group, an optionally substituted C_{1-6} alkoxy group and a halogen atom, and R^{16} and R^{17} are the same or different and each is a hydrogen atom, a halogen atom, a C_{1-6} alkyl group or a C_{1-6} alkoxy group.

17. The compound of claim 16, wherein R^{11a} is a phenyl group having two substituents selected from an optionally substituted C_{1-6} alkyl group, an optionally substituted C_{1-6} alkoxy group and a halogen atom; Ea is a bond, an oxygen atom or a methylene; and R^{16} and R^{17} are the same or different and each is a hydrogen atom or a halogen atom.

18. The compound of claim 17, wherein Ea is a bond.

19. The compound of claim 17, wherein R^{16} is a hydrogen atom, and R^{17} is a fluorine atom.

20. The compound of claim 16, wherein the partial structural formula



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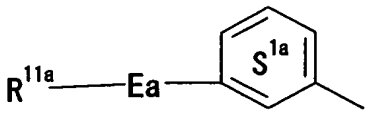

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21. The compound of claim 20, wherein R^{11a} is a phenyl group having two substituents selected from an optionally substituted C_{1-6} alkyl group, an optionally substituted C_{1-6} alkoxy group and a halogen atom; Ea is a bond; and ring S^{1a} is a benzene ring without additional substituent.

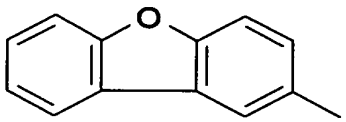
22. The compound of claim 13, wherein the substituent(s) having a benzene ring is a substituent represented by the formula: R^{11}-E^2- (R^{11} is a phenyl group, an indanyl group or a naphthyl group, each optionally having substituent(s), and E^2 is a bond or a spacer), ring S^1 is optionally further substituted by a C_{1-6} alkyl group, and R^{11} optionally forms a ring together with E^2 and ring S^1.

23. The compound of claim 22, wherein R^{11} is a phenyl group or an indanyl group, each optionally having substituent(s) selected from the group consisting of a halogen atom, a nitro, a carboxy, an optionally halogenated C_{1-6} alkyl, a hydroxy-C_{1-6} alkyl, a carboxy-C_{1-6} alkyl-carbonylamino-C_{1-6} alkyl, an optionally halogenated C_{1-6} alkoxy, a C_{6-14} aryl, a C_{6-14} aryloxy and a C_{7-16} aralkyloxy,

E^2 is a bond, -O-, $-CH_2-O-$, -CO-, -CONH-, $-N(CH_3)CH_2-$, $-S-CH_2-$

or -C=C-,

ring S^1 is optionally further substituted by a C_{1-6} alkyl group, the ring formed by R^{11} together with E^2 and ring S^1 is



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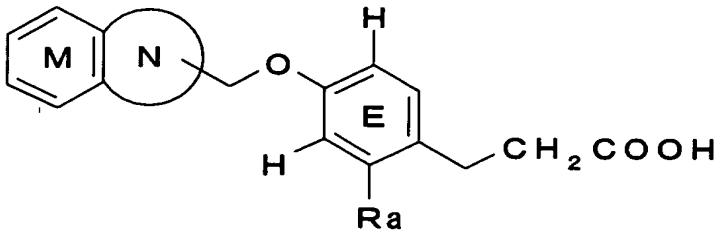
the substituent that ring R optionally has is a C_{1-6} alkyl group, and Ra is a hydrogen atom.

24. A compound represented by the formula



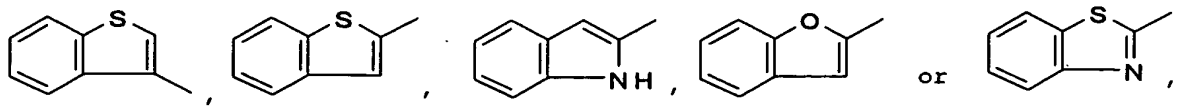
(I-3)

wherein ring M is a benzene ring optionally having substituent(s), ring N is a 5-membered heterocycle optionally having substituent(s), ring E is a phenylene group optionally having substituent(s), and Ra is a hydrogen atom or a substituent, or a salt thereof, except 4-(1H-benzotriazol-1-ylmethoxy)benzenepropanoic acid and 4-(1H-indol-3-ylmethoxy)benzenepropanoic acid.

25. A prodrug of the compound of claim 24 or a salt thereof.

26. The compound of claim 24, wherein the partial structural formula

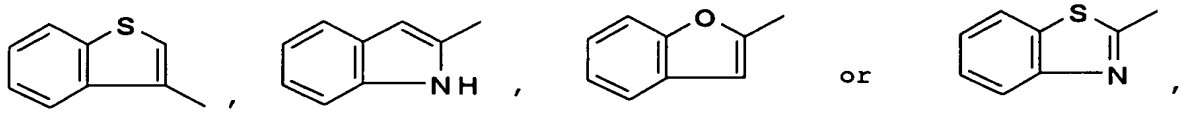
is



each optionally having substituent(s) selected from a halogen atom, an optionally substituted C_{1-6} alkyl group, an optionally substituted C_{1-6} alkoxy, a C_{1-6} alkoxy-carbonyl and an optionally substituted C_{7-16} aralkyloxy.

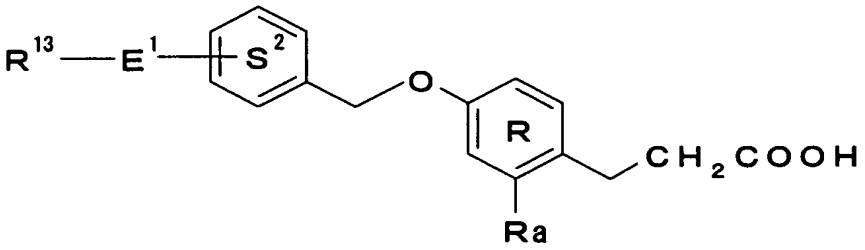
27. The compound of claim 24, wherein the partial structural formula

is



each optionally having substituent(s) selected from a halogen atom and an optionally substituted C_{1-6} alkyl group, ring E is an unsubstituted phenylene group, and Ra is a hydrogen atom.

28. A compound represented by the formula



(I-4)

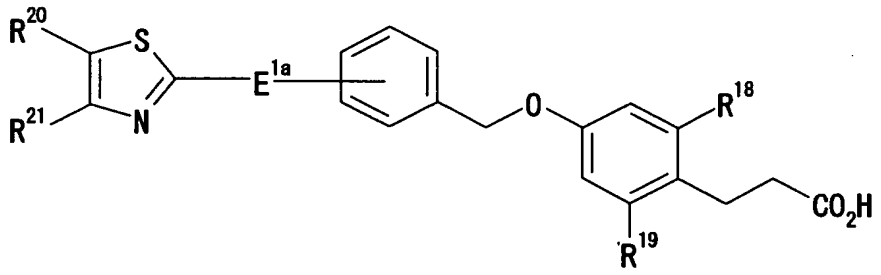
wherein ring S^2 is a benzene ring optionally having substituent(s), ring R is a phenylene group optionally having substituent(s), E^1 is a bond or a spacer, R^{13} is a thiazolyl group optionally having substituent(s), and Ra is a hydrogen atom or a substituent, or a salt thereof.

29. A prodrug of the compound of claim 28 or a salt thereof.

30. The compound of claim 28, wherein ring S^2 is a benzene ring, ring R is an unsubstituted phenylene group, R^{13} is a thiazolyl group optionally having substituent(s) selected from a C_{6-14} aryl and a C_{1-6} alkyl, E^1 is $-N(R^{14})-(CH_2)m^2-$ or $-S-(CH_2)m^2-$ (R^{14} is a hydrogen atom or a C_{1-6} alkyl group, and m^2 is an integer of 0 to 3), and Ra is a hydrogen atom.

31. The compound of claim 28, wherein R^{13} is a 2-thiazolyl group optionally having substituent(s).

32. The compound of claim 28, which is represented by the formula



(I-4A)

wherein E^{1a} is $-N(R^{14})-CH_2-$, $-CH(R^{22})-O-$ or $-CH(R^{22})-CH_2-$ (R^{14} and R^{22} are a hydrogen atom or a C_{1-6} alkyl group), R^{18} and R^{19} are the same or different and each is a hydrogen atom, a halogen atom, a C_{1-6} alkyl group or a C_{1-6} alkoxy group, and R^{20} and R^{21} are the same or different and each is a hydrogen atom, an optionally substituted C_{6-14} aryl group or an optionally substituted C_{1-6} alkyl group, or R^{20} and R^{21} are bonded to form a ring.

33. The compound of claim 32, wherein E^{1a} is $-N(R^{14})-CH_2-$ (R^{14} is a hydrogen atom or a C_{1-6} alkyl group), and R^{18} and R^{19} are the same or different and each is a hydrogen atom or a halogen atom.

34. A pharmaceutical agent comprising the compound of claim 10, 13, 24 or 28 or a salt thereof or a prodrug thereof.

35. A method of regulating a GPR40 receptor function, which comprises administering an effective amount of a compound having an aromatic ring and a group capable of releasing cation to a mammal.

36. Use of a compound having an aromatic ring and a group capable of releasing cation for the production of a GPR40 receptor function regulator.

37. A screening method for a ligand, agonist or antagonist to GPR40, which comprises using GPR40 or a partial peptide thereof or a salt thereof, and a compound having an aromatic ring and a group capable of releasing cation.

38. A kit for screening a ligand, agonist or antagonist to GPR40, which comprises GPR40 or a partial peptide thereof or a salt thereof, and a compound having an aromatic ring and a group capable of releasing cation.